A Bioassay to Assess Bioactivity of Saflufenacil in Western Canadian Soils

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Introduction

Saflufenacil herbicide, developed by BASF, is used for control of broadleaf weeds via pre-plant and pre-emergence applications to a wide range of crops such as barley, canary seed, chickpea, field pea, oat, and wheat. Saflufenacil is a Group 14 herbicide (the pyrimidinedione chemical class), and it works by inhibiting protoporphyrinogen oxidase (PPO), which causes lipid peroxidation resulting in rapid loss of cell membrane integrity.

Objectives

The objectives were: (1) to develop a plant bioassay for detection of saflufenacil in soil, (2) to apply the bioassay to examine how soil conditions affect saflufenacil bioactivity in prairie soils.

Soils

Ten western Canadian soils were used for the study of saflufenacil bioavailability (Table 1).

Table 1. Selected soil characteristics.

Soil (location)	Soil Textural Class	Organic Matter (%)	pH	Clay (%)
Saskatoon (BASF)	loam	3.0	6.8	17
Regina (BASF)	heavy clay	3.2	8.1	62
Lethbridge (BASF)	sandy clay loam	2.6	7.7	26
Camrose (BASF)	silt loam	7.9	6.6	17
Winkler (BASF)	sandy loam	3.0	7.8	12
Central Butte (1)	sandy loam	2.2	7.9	14
Central Butte (2)	loam	3.8	7.2	36
Saskatoon	silty clay loam	5.5	7.8	50
Scott	loam	3.4	5.0	23
Melfort	clay	11.4	6.1	72

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Development of plant bioassay for detection of saflufenacil in soil

Materials and Methods

Sugar beet, canola, mustard, and lentil were tested and shoot lengths were measured in response to the soil-incorporated saflufenacil at 57.4 ppb. The bioassay was performed in 2-oz WhirlPak™ bags and plants were grown in the laboratory under fluorescent lights.

Results

Of the crops tested, sugar beet was the most sensitive (Fig. 1). Measuring shoot length inhibition of sugar beet after 7 days of growth was selected as suitable for detection of saflufenacil in soil (Fig. 2).

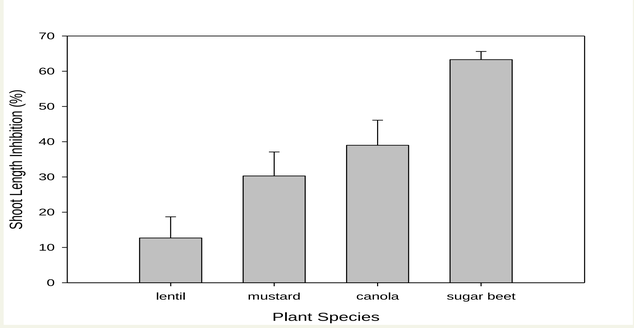

Fig. 1. Shoot length inhibition (%) of different crops grown in soil amended with saflufenacil at 57.4 ppb.

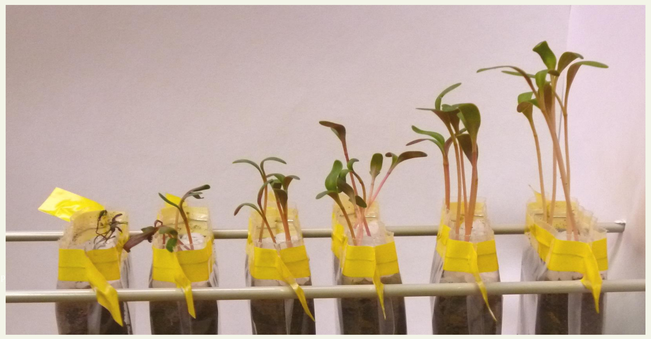

Fig. 2. Seven day sugar beet biosassay performed in WhirlPak™ bags in the saflufenacil concentration range from 0 to 76.5 ppb.

Saflufenacil bioactivity

Materials and Methods

Bioactivity was assessed by measuring sugar beet shoot response to increasing concentration of saflufenacil from 0 to 76.4 ppb in the ten western Canadian soils (Table 1).

Results

GR_{50} values (concentration required for 50% shoot length inhibition) for each soil were determined from the dose-response curves (Fig. 3). The GR_{50} values ranged from 9 to 55 ppb, and increased generally in the same order as percent organic carbon ($p = 0.011$, Table 2) thus indicating that saflufenacil adsorption to organic matter may lower saflufenacil bioactivity.

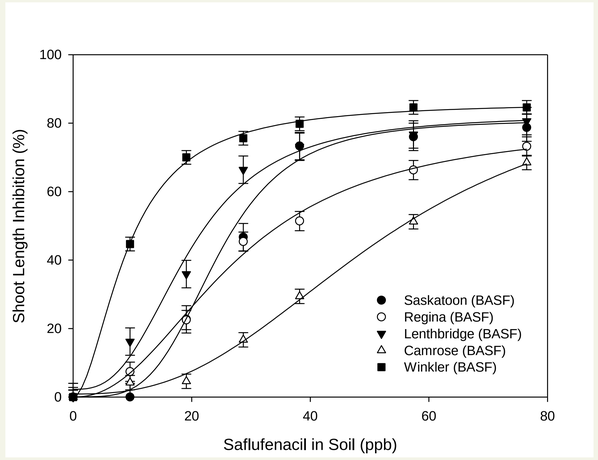

Fig. 3. Shoot length inhibition of sugar beet in response to increasing concentration of saflufenacil in selected western Canadian soils.

Table 2. Multiple regression analysis for the GR_{50} values and soil characteristics.

Model	Coefficient	Standard error	P value
Intercept	-10.4	25.6	
% Organic Matter	4.9	1.4	**0.011**
pH	2.6	3.3	0.465
% Clay	-0.06	0.2	0.752